Before the
Federal Communications Commission
Washington DC 20554

In the Matter of	)	
	)	
Modification of Parts 2 and 15 of the	)	ET Docket No. 03-201
Commission's Rules for Unlicensed	)	
Devices and Equipment Approval	)	

Comments of GlobespanVirata, Inc.

Mitchell Lazarus
FLETCHER, HEALD & HILDRETH, P.L.C.
1300 North 17th Street, 11th Floor
Arlington, VA 22209
703-812-0440
Counsel for GlobespanVirata, Inc.

January 23, 2004

TABLE OF CONTENTS

Before the
Federal Communications Commission
Washington DC 20554

In the Matter of	)	
	)	
Modification of Parts 2 and 15 of the	)	ET Docket No. 03-201
Commission's Rules for Unlicensed	)	
Devices and Equipment Approval	)	

Comments of GlobespanVirata

Pursuant to Section 1.415 of the Commission's Rules, GlobespanVirata, Inc. files these comments in the above-captioned proceeding.[1] GlobespanVirata is a leading provider of DSL and wireless networking chip sets, software, and reference designs to leading global manufacturers of broadband access and wireless networking equipment. GlobespanVirata applies the industry's longest history in DSL and wireless networking development and deployment to support more than 400 customers.

A. Summary

As detailed below, GlobespanVirata generally supports the Commission's proposals to provide additional flexibility and consistency in the Part 15 Rules. Many of the proposals should be adopted as is, or with very little change. These include proposals relating to advanced antenna technologies, measurement procedures, hopping rules, units imported for evaluation, and laboratory accreditation.

In other areas we agree with the Commission's goals, but believe they are better addressed by industry standards bodies than by regulation. Spectrum etiquettes, for example, may be wise in principle, but their imposition by regulatory *fiat* would almost certainly disadvantage some users, and the resulting rigidity would be likely to thwart innovation. The

---

[1] *Modification of Parts 2 and 15 of the Commission's Rules for Unlicensed Devices and Equipment Approval*, 18 FCC Rcd 18910 (2003) ("Notice").

industry has repeatedly shown it has both the motive and the capability for responsible spectrum management. Similarly, protocols for the interfaces between components of a partitioned modular transmitter should be specified by industry, not the Commission.

On still other topics, we again support the Commission's goals, but show that additional measures may be needed to protect the radio-frequency environment. For example, we agree developers should be able to substitute antennas of equal or lower gain than those originally certified, but note the rule should apply at the harmonics as well as the operating frequency. We agree providers should be able to mix and match power amplifier and antenna components, but the original certification should offer publicly available guidelines and specifications to promote continued compliance. The Commission's proposals for modular certification are timely and badly needed, but may require added specificity so that careless or unscrupulous developers cannot combine compliant components into products that cause interference.

In short, the Commission's proposals will promote the ongoing growth and burgeoning variety of Part 15 devices. GlobespanVirata requests attention to the points itemized below to ensure interference-free communications as devices continue to multiply.

B. The Commission Should Adopt its Proposals on Advanced Antenna Technologies.

GlobespanVirata agrees there is a need for new regulations to support advanced antenna technologies. There are marked advantages to a flexible approach to sectorized antenna rules that would cover traditional transmitters with sectorized or phased array antenna systems, as well as new advances, particularly in the areas of "multi-antenna diversity" and "smart antenna" technology.

We agree with the IEEE802 recommendation that the classification be broadened to include future developments such as MIMO radio systems, and multiple antenna systems that employ forms of Space Time Coding or layered coding.[2]

We note that the IEEE802.11 standards group is embarking on the development of a new high-throughput WLAN radio standard, 802.11n, that could incorporate these types of antenna and system advancements. We anticipate rapid development in the areas of "smart antenna" technologies.

The Commission seeks comment on the characteristics that a system would need to exhibit for classification as a sectorized or phased array antenna system.[3] At this time, we see no need to differentiate between systems that use adaptive antenna techniques *vs.* fixed beam techniques, beyond the criteria in the Notice. But we suggest the Commission acknowledge that these characteristics and their impact on conventional wireless communication systems will evolve in the context of emerging system standards, so that whatever rules the Commission adopts may need adjustment going forward.

C. The Commission Should Adopt its Proposals on Replacement Antennas.

GlobespanVirata strongly supports more flexible antenna replacement policies. As unlicensed devices have become more sophisticated, the antenna rules have held back performance and increased costs to the end user.

More flexible antenna rules will be especially useful to the growing numbers of developers who include integral antennas in their products and have multiple suppliers for the

---

[2] IEEE WG18 18-04-0073, Comments on Changes to Part 2 and Part 14.

[3] Notice at para. 11.

radios. An example is laptop computers, which usually have the antenna integrated into the unit, while the wireless LAN device is installed in a mini-PCI slot. The slot and the internal antenna connectors are standardized, which allows a number of different vendors to supply the radio product. In this case the flexibility is not primarily for end users, but for laptop manufacturers. The end user benefits from reduced cost and increased features, while the OEM benefits from reduced time to market.

The Commission proposes to allow replacement with any antenna of the same type as that certified, and the same or lower gain.[4] But antenna gain must be considered for both in-band and out-of-band cases. The out-of-band rules should specifically address the gain at the second and third harmonics of the carrier(s). For example, a proposed replacement antenna might have less in-band gain than the antenna tested for certification, but more gain at the second harmonic. If the original device relied on the original antenna to suppress second-harmonic spurious emissions, the replacement antenna could take the unit out of compliance. The problem could be addressed by adding a condition that a replacement antenna not only maintain the same or lower gain as the original not only in band, but also at critical out-of-band frequencies. If the replacement antenna has higher out-of-band gain than the original, then the antenna replacement should be treated as a Class II permissive change.[5] We are not proposing to extend the capability of changing antennas to end users.

---

[4] Notice at para. 17.

[5] *See* 47 C.F.R. Sec. 2.1043(b)(2).

D. The Commission Should Adopt its Proposals on Flexible Equipment Authorization, with Modifications.

GlobespanVirata supports the Commission's proposals for increased flexibility in equipment authorization, with the qualifications set out below.[6]

The flexibility to mix and match power amplifier and antenna components is just as important to OEMs that embed modular radio systems within their products as it is to wireless Internet service providers. Some OEMs also may wish to use newer partitioned modular radio implementations.

We suggest the risk resulting from increased flexibility can be minimized if the original certification applicant provides appropriate guidelines and specifications for component substitution with the certification application. The FCC ID on the device label would key to this publicly-available information on the Commission website. Component suppliers and OEMs would be responsible for following these guidelines and specifications.

We agree with limiting the authorization for separately marketed power amplifiers to 5.75-5.85 GHz operation. But further requirements may be warranted to prevent abuse. For example, the Commission might ask the certification applicant to show that (1) the radio cannot operate outside the 5.75-5.85 GHz band with the power amplifier attached; and (2) the combination of radio and power amplifier cannot exceed specifications set out in the original certification application. We would also support a provision that limits marketing of the add-on power amplifier to the same parties that market the original radio.

---

[6] *See* Notice at paras. 18-20.

E. The Commission Should Adopt its Proposals on Measurement Procedures for Digital Modulation Systems.

GlobespanVirata supports consistent measurement procedures for digital modulation and U-NII systems. We see no problem in adopting average power rules for all digital modulation devices, as under the U-NII rules.

The Commission should clarify, however, that the average is measured and calculated only during actual transmission. It would be very disruptive to allow short duty cycle, high power transmitters to time-integrate the "average" over the on and off portions of the duty cycle.

Finally, because of the potential impact of any such changes, we ask the Commission to put its final proposal on public notice for comment before it is implemented.

F. The Commission Should Adopt its Proposals on Modular Certification, with Modifications.

GlobespanVirata strongly supports the concept of "modular certification," and agrees with the Commission on the need to codify the criteria. The industry and the public will be well served by these changes. But we point out a few important issues that must be resolved to achieve this goal.

1. "Firmware"

The Notice distinguishes between the "radio front end" and the "firmware," each of which can be self-contained units.[7] We note the term "firmware" has multiple meanings in industrial applications, and hence can be confusing. We suggest replacing the term "firmware" with "digital radio controller," which includes the digital control and signal processing functions, external to the radio front end component, that control radio operation over a digital interface. The digital

---

[7] Notice at para. 33.

radio controller may be implemented with hardware, firmware, or a combination of the two, and may include elements that are able to affect the power or spectral characteristics of the RF output.

2. Power supply regulation

The Notice proposes to retain the requirement that the modular transmitter have its own power supply regulation.[8] We agree with the intent, but suggest some clarifications. First, not all sections of the module need to have power regulation. The power amplifier is generally fed directly from the external supply since it is less sensitive to supply variations and noise, and more sensitive to voltage drops. Second, the VCO and the synthesizer circuits that might be sensitive to noise and variation from the supply could be isolated in ways other than a separate regulator. Thus we propose wording along these lines: "The modular transmitter must have sufficient internal regulation as to be isolated from variations and noise in the external supply." We would also suggest that the manufacturer include requirements on the external power supply in the instructions referred to in paragraph 35(7). These should typically include voltage tolerances, ripple, and noise levels. Manufacturers using the module in a higher-level product would have to meet these requirements in order to utilize the module certification.

3. Antenna coupler

The Notice proposes to retain the requirement that a modular transmitter comply with the antenna requirements of Section 15.203 and 15.204(c) -- that the antenna must either be permanently attached or employ a "unique" antenna coupler.[9] GlobespanVirata urges the Commission to apply to modular transmitters the same antenna flexibility it has proposed for

---

[8] Notice at para. 35(3).

[9] Notice at para. 35(4).

antennas in general -- *i.e.*, a manufacturer should be able to substitute an antenna of the same type as that certified, with the same or lower gain.[10] In the context of antennas generally, the Commission proposes that manufacturers "be expected to supply a list of acceptable antenna types and the corresponding specifications with the applications for equipment authorization."[11] In the case of a modular transmitter, that information should become part of the instructions referred to in paragraph 35(7). Moreover, our comments in Part C above, on antenna gain at the harmonics, apply equally in the context of a modular transmitter. We do not dispute the unique-coupler requirement intended to keep end users from substituting an antenna that might violate regulations and cause excessive interference.

4. Labeling

The Notice proposes to retain the requirement for an FCC ID label on the modular transmitter and, if that is not visible when installed in the host device, then on the host device as well. We suggest adding the following words to the rule text: "Use of this external label implies that the device into which the module is installed meets the requirements of the manufacturer as specified in the manufacturer's instructions document submitted as part of the original equipment authorization." This squarely puts responsibility on the host device manufacturer to meet the requirements specified in the modular authorization.

5. Instructions

The Notice proposes to retain the requirement that an application for certification of a modular transmitter include any pertinent instructions relating to applicable operating

---

[10] Notice at paras. 16-17.

[11] Notice at para. 17.

requirements.[12] GlobespanVirata strongly endorses this requirement and sees it as critical to effective regulation of modular transmitters. Without the requirement, the manufacturer loses all control over aspects of the environment that could take the radio out of compliance and possibly cause an interference condition.

6. Interference testing

The Notice seeks comments regarding "alternative methods of demonstrating compliance with the FCC rules, including: (a) impulse interference testing similar to that used in EN61000-4-4; (b) using a two-tone interference test and coupling the interferers into the cabling; and ©) looking at interference levels required to degrade the bit error rate of the interference to an unacceptable level . . . ."[13] The same paragraph suggests that the interface must be digital with a signaling amplitude of at least 150 mV peak-to-peak.[14]

GlobespanVirata agrees that the interface between the radio front end and the digital radio controller sections of the modular system must be digital with a minimum signaling amplitude of 150 mV peak-to-peak. Such an interface may transport both digital signal information and control information for the transmitter, which may be multiplexed together through a single interface, as exemplified in the JEDEC JC-61 RF-BB Interface draft standard.

Compliance with the Commission's Rules will require appropriate certification tests and re-certification guidelines for all the elements defined in a partitioned modular transmitter system, including the parts of the digital interface between front end and controller that can affect

---

[12] Notice at para. 35(7).

[13] Notice at para. 38.

[14] *Id*.

transmitter RF operation. Thus, it is important that the rules include required certification tests on representative reference platforms to ensure that the modular components and interface operate in a compliant manner when integrated together in different product environments. They must operate at all times as a compliant system. (See also Part F.8 below, on reference platform.) We agree that the certification tests should include demonstrated compliance when the digital interface is subjected to maximum possible interfering noise of both normal and abnormal nature.

Methods of demonstrating compliance should include at a minimum: (a) injection of common mode noise between the local ground systems of the radio front end and the digital radio controller (normal operation); and (b) injection of interfering pulses that cause the bit error rate of the digital interface to degrade substantially and in a random manner (representing abnormal operation). Digital interfaces will likely vary substantially in capability, and most interface implementations will have typical bit error rates less than 10^{-12}. Test methods should be flexible enough to ensure a substantial degradation of error rate during the test (*e.g.*, $>10^{-4}$) so that corruption events can be measured within standard RF spectral tests and with reasonably efficient test times.

For many partitioned modular radio systems, it will not be practical to measure the interface bit error rate directly during radio operation or during a certification test. Therefore, we suggest limiting the test platform requirement to include means to inject random error pulses from an external source, either by direct analog coupling to the interface lines or by injecting them digitally within the digital radio controller. Either method will ensure that interface bit errors in the transmit control stream can be produced reliably during the test, without the necessity of directly measuring the error rate. One or both of these methods should be suitable alternatives to the methods mentioned in the Notice (*i.e.*, impulse interference testing similar to that in

EN61000-4-4, and two-tone interferers coupled into the cabling), since they ensure corruption of the interface for a wide range of possible digital interface designs.

For interference injection with direct analog coupling to the interface, the required interference levels will vary depending on the type and design of the digital controller interface. Appendix A provides a brief description with examples of suitable interference injection methods for a JEDEC JC-61 RF-BB type of interface. (This material is for informational purposes and is not suggested for inclusion in the Commission's Rules.)

As discussed further below, the Part 15 rules will need specific requirements and guidelines for "reference platform" compliance testing. Specifically, the interface interference testing method, and parameters, and the impact on RF spectral measurement methods, number of tests required, and total test time all need careful consideration. We support the codification of these additional requirements into the new Section 15.212 for modular transmitters.

7. Buffered input

The Notice proposes to amend the existing requirement for buffered modulation input as to partitioned modules, so as to allow control information (frequency, power, and radio operation) and other data to cross the interface between the firmware and the radio front end.[15] GlobespanVirata agrees the definition of transmit interface must be expanded to allow control information and other data to cross the interface. With a serial interface such as the JC-61 RF-BB interface, these data types are typically multiplexed together over the same physical interface data link. This contributes to making the module feasible. If control and data had to be separated, the increased cost of I/O pins, cables and connectors, and increased size of the module would all

---

[15] Notice at para. 39.

undercut the benefits of using a modular configuration. It would also make the JC-61 interface unsuitable for module certification, which would remove a significant benefit of the interface. The testing requirements proposed here are sufficient to assure the combined interface remains effective.

8. Reference platform

The Notice proposes to define a "reference platform" that the radio manufacturer would build and submit for testing, consisting at a minimum of the radio front end, antenna, and an "environment" such as a PDA or laptop on which the firmware will operate.[16] Any future changes to the radio front end or firmware would require re-testing on the pre-approved reference platform.[17]

GlobespanVirata agrees with the proposed minimum reference platform for certification. To the greatest extent possible, the platforms tested should be representative of the digital interface characteristics and operational modes used in possible product applications involving the radio module. The module manufacturer is responsible for providing usage guidelines and for noting any platform implementation limits that may affect proper transmitter operation. This information can be provided in the requirements instructions submitted with the application for certification.

The reference platform may have to be further defined to give clear guidance to industry and the Telecommunication Certification Bodies as to what will be considered representative of the applications suitable for testing. Length of cables and power supplies at the limits of voltage

---

[16] Notice at para. 40.

[17] *Id*.

and noise are examples of the items needing further definition. One possible approach is to have the reference design platform operation instructions define the limits of operation of any module certified using the platform.

The rule text should clarify the definitions of "reference platform" and "firmware" in line with the concept of partitioning into a radio front-end and digital radio controller connected through a digital interface. The reference platform should include a representative implementation of the intended radio components, interface, and firmware, and representative instances of mix-and-match system components that are to be tested and certified for Commission compliance.

A clear line should be drawn around the elements of hardware or firmware external to the radio module that impact transmit control and could affect compliance of the transmitter unit. Retesting would be required for future changes to the front end module or any of the relevant external digital controller functions, including firmware changes, which impact the transmit control and could impact compliance.

On the other hand, there should be some provision for system changes that do not impact radio transmitter control functionality, including IC architecture and process changes in the digital controller and the many types of non-consequent hardware or software changes that occur naturally in controller instantiations within a modern product life cycle. These should come within the existing Class I/Class II permissive change regime.[18]

---

[18] 47 C.F.R. Sec. 2.1043(b).

Finally, the reference platform should be fully equipped for required digital interface interference testing and for tests in representative configurations and radio operating modes specified by the radio component suppliers and to be covered by the certification.

The Notice proposes that signal injection testing be done on the implementation with a maximum length of cabling connecting the modular components, and seeks suggestions on the design of a reference platform and the length and type of cable used. We note that the partitioned system model discussed so far may include any type of digital interface with signaling level above 150 mV peak-to-peak (presumably at the line receiver side of the interface). Depending on product application, such an interface may use a wide variety of physical interconnection schemes, as specified by radio component suppliers. It is not practical to specify *a priori* the length and type of cables for all implementations.

In general, however, the reference platform should be representative of worst-case interface conditions. We suggest that maximum controller interface interconnect lengths be represented in the test platform, and that the platform be provisioned with inputs and instructions to properly inject worst case common mode noise and interfering signals at the critical digital radio controller interface. Further suggestions are contained in the JEDEC JC-61 interface examples provided in the attached Appendix A.

9. No mix and match

The Notice proposes to add a new requirement specific to partitioned modular transmitters to ensure that a radio front end and firmware that have been certified together as a pair may

operate only with one another, by implementing a unique digital key or "type number" that allows approved radio front ends and firmware to recognize each other.[19]

GlobespanVirata agrees with the concept of interlocking the front-end module and the control and processing functions to prevent operation with units not designed to function together. A simple test can show that a unit will not operate when the interlock mechanism is changed. Such a test should be required to prevent inadvertent combinations of units that could violate regulations. The controller (with associated firmware) should be responsible for verifying compatibility of the front-end module that is connected prior to operation.

We suggest that the numbers that implement the interlock not be encrypted, due to the additional complexity this will add to the interface and the parts. Further, we suggest that an existing industry group such as JEDEC handle the allocation and assignment of numbers. As an example, the soon-to-be-approved JEDEC JC-61 already includes this ID definition and allocation.

G. The Commission Should Leave Spectrum Etiquettes to Industry.

The Notice asks whether the Commission should adopt a spectrum etiquette to promote sharing in the unlicensed bands.[20] GlobespanVirata agrees with the concept of spectrum etiquettes in principle, but believes their specification should be left to the industry. It would be extremely difficult to put together a single etiquette requirement that is fair to existing devices in the field and would not increase the cost of new devices significantly. For example, while current 802.11 systems utilize CSMA to control the spectrum usage fairly, not all unlicensed transmitter

---

[19] Notice at para. 41.

[20] Notice at paras. 43-45.

technologies in the band utilize this mechanism. Additionally, implementing spectrum-sharing rules without insight into industry activities may prove restrictive. The 802.11 working group is currently investigating methods to increase end-user throughput for purposes of improved user experience and broader market potential. The ultimate impact of this activity on the medium access characteristics of 802.11 technologies is still unknown. In short, implementing spectrum-sharing rules prematurely will only stifle innovation.

Industry has every motive to accept a role in specifying etiquettes, as poor spectrum utilization will adversely impact performance and user satisfaction. Activities by the Bluetooth co-existence group (IEEE 802.15.2) and the radio resource management group within 802.11 as well as 802.19 (Coexistence Technical Advisory Group) demonstrate industry resolve to manage spectrum resources responsibly.

H. Other Matters

Hopping rules. GlobespanVirata agrees the channel separation rule could beneficially be set at the greater of 25 kHz or 2/3 bandwidth.[21] Frequency hopping systems should be allowed to adaptively avoid interfering signals from other systems. The 2/3 bandwidth rule will serve to increase the number of available hopping channels, while improving the interference immunity among those devices when coupled with the 125mW output power limit.

Special temporary authority. GlobespanVirata supports the proposal to remove provisions for special temporary authority.[22]

---

[21] *See* Notice at paras. 25-30.

[22] Notice at para. 46.

Units imported for evaluation. GlobespanVirata supports HP's request for an increase in the number of units that may be imported for evaluation to 2,000.[23] We also agree the rule language should be specific enough to ensure the devices are not commercially deployed. But we do not see any practical method to track and retrieve every device. It would simpler to require that each device be permanently labeled to make clear it is provided as a sample for test purposes only, and to identify the responsible party.

Electronic filing. GlobespanVirata supports the conversion to mandatory electronic filing,[24] thanks to the now ubiquitous ability to prepare and transfer documents in electronic form.

Laboratory accreditation. GlobespanVirata supports the laboratory re-accreditation proposals.[25] Given the rate at which equipment technology, test methods, and regulations change, the Commission must be satisfied at all times that each lab offering test services is properly equipped and fully knowledgeable.

CONCLUSION

The Commission's Part 15 rules have been a great success in facilitating wireless communications when and where they are needed, at low cost and without the added expense and delay of licensing. The very large number of unlicensed devices sold annually is ample proof the regime works well. With the popularity of such products as cordless telephones, Wi-Fi laptops, wireless audio gear, automotive entry systems, remote control toys, etc., an ordinary residence can easily house a dozen or more unlicensed devices. Commercial and industrial applications add

---

[23] Notice at paras. 47-53.

[24] Notice at paras. 54-56.

[25] Notice at paras. 57-58.

countless others. Yet this vast multiplicity of devices operates with almost no interference and surprisingly good reliability.

One key to the industry's success has been manufacturers' flexibility to innovate, meet competition quickly, and respond to costumers' changing needs and tastes. Added flexibility is therefore in the public interest, so long as it does not threaten to increase interference. The Commission can serve the pubic well by promptly adopting its proposals with the qualifications noted above.

Respectfully submitted,

Mitchell Lazarus
FLETCHER, HEALD & HILDRETH, P.L.C.
1300 North 17th Street, 11th Floor
Arlington, VA 22209
703-812-0440
Counsel for GlobespanVirata, Inc.

January 23, 2004

APPENDIX A. DIGITAL INTERFACE INTERFERENCE TESTING METHODS FOR A PARTITIONED SYSTEM WITH JEDEC JC-61 RF-BB INTERFACE

Background

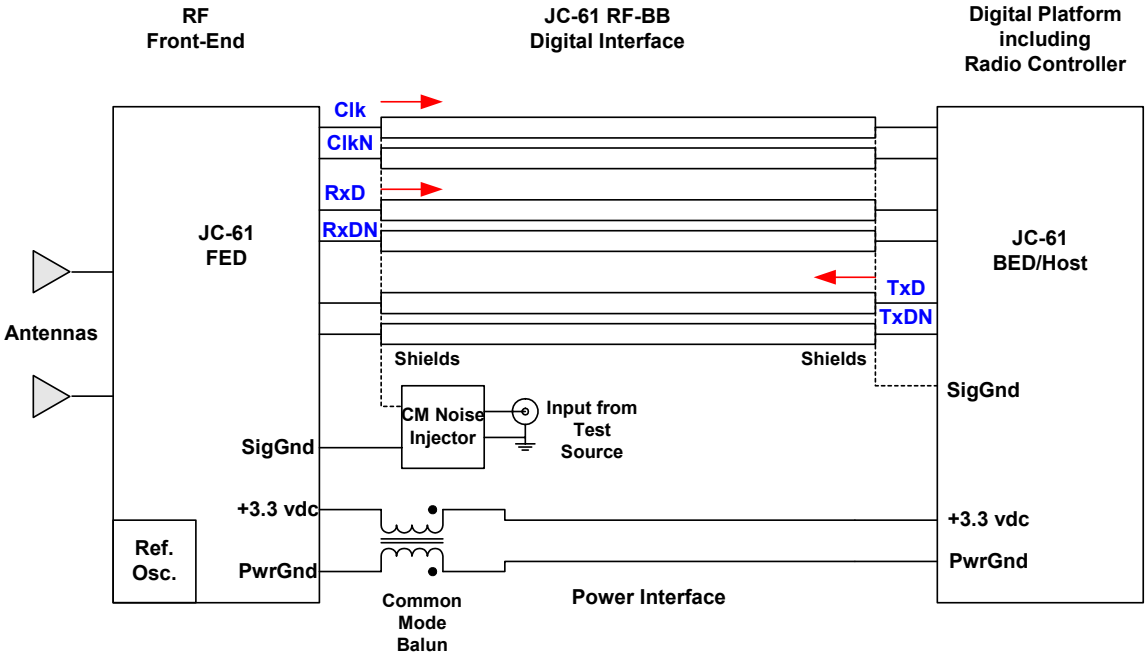
The block diagram of Figure 1 shows a modular Wireless LAN radio system partitioned as an RF front end transceiver module (FED) connected to a digital radio controller backend device (BED). The FED and BED are connected through a JC-61 RF-BB Interface. The JC-61 RF-BB interface is a high-speed differential serial data interface comprised with 3 differential signal pairs: clock from FED to BED; Rx Data from FED to BED; and Tx Data from BED to FED. In this configuration, digital signal and control data to the FED transmitter are multiplexed over the TxD pair.

The 6-wire serial interface is electrically similar to standard serial computer I/O interfaces.

Serial data rates on the TxD interface can range from about 400 Mbps to over 1.6 Gbps during packet transmission in the WLAN radio module. The length of the digital interface may be up to 1 meter. However, a wide range of lengths may be utilized in products, some involving only very short point-to-point IC interconnections.

For FCC certification testing of such a modular system, a reference platform would be provided with representative maximum distance interconnect loading, and with provisions to inject normal and abnormal interfering signals into the interface from standard external test equipment.

Figure 1: Modular Radio System with JC-61 RF-BB Digital Interface



Common Mode Noise Injection Test Method

Figure 1 also shows a method for coupling a broadband common mode noise interference into a test reference platform with this type of interface. It is assumed that the reference platform has provisions to isolate the common grounds for the FED section and BED sections of the platform, allowing a common mode offset to be introduced at the line receiver side of the TxData interface. The digital interface interconnect may be in the form of controlled impedance PCB traces or one of several types of transmission line cables.

A common mode balun is inserted into the power supply lines in order to isolate the supply impedance from the common mode difference of the two sides. A CM injection circuit is connected between the normal signal ground of the RF front-end and the return shields of the interface interconnect, on the RF module side. This allows a relatively broadband common mode noise interference signal to be injected at the TxData receiver input from a 50 ohm test signal generator.

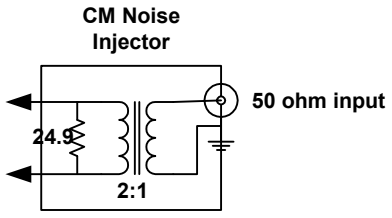
The JC-61 RF-BB Interface is specified to operate with up to 200 mV peak-to-peak common mode noise, with spectral energy distributed anywhere in the DC to 200 MHz region.

For this example, an appropriate CM interference test might use one of two different test signals, injected as shown:

1.) 200 mV peak-to-peak CW swept between 1 MHz and 200 MHz; or
2.) 40 mV rms random noise with uniform spectrum between 1MHz and 200MHz

An example injector circuit is shown in Figure 2.

Figure 2:



This example is meant for informational purposes only. Specific test requirements and parameters are not meant to be indicated here, only an appropriate platform injection method.

The common mode noise injection tests simulate a worst case implementation environment as a bound for all likely product implementations with the modular radio components. Certified modular components may be implemented in a variety of different product packages. Common mode ground noise is a normal part of any packaging where there is significant interface distance between the RF front end module and the digital radio controller. This test is for robustness of the RF transmitter behavior relative to various package implementations.

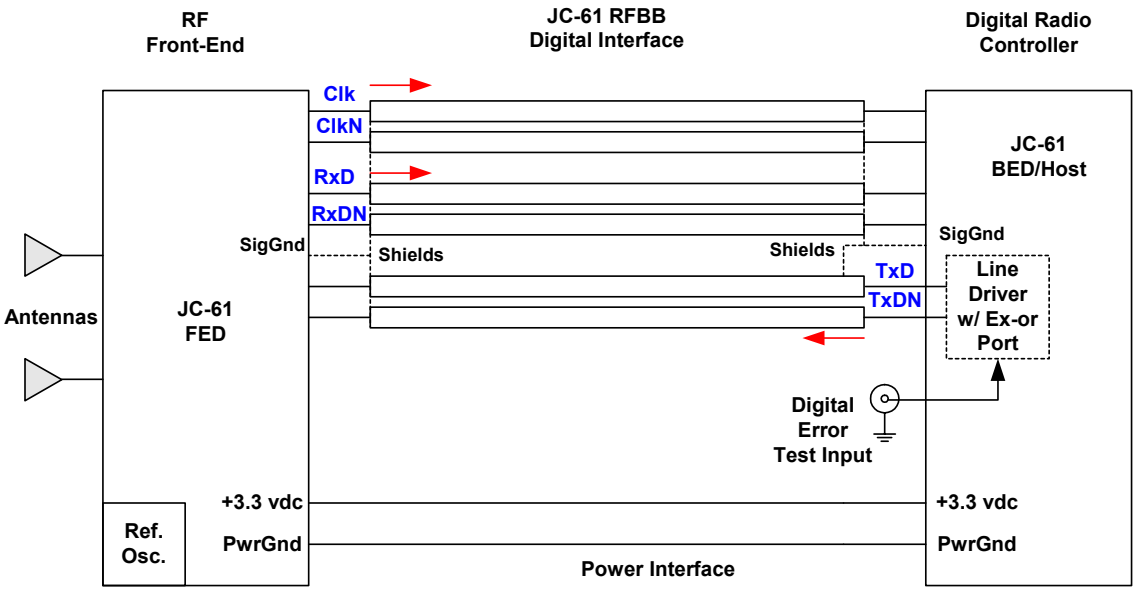
Pulsed Interference Injection Test Methods

The pulse interference tests suggested in comments for paragraph 38 are intended to measure the RF transmitter behavior in the presence of abnormal occurrences strong pulsed noise on the digital interface that cause bit errors.

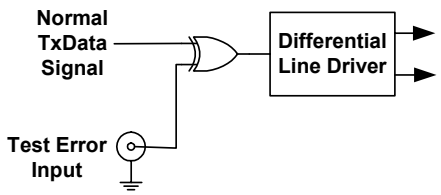
The examples below suggest two possible ways to introduce the bit errors from an external test source: 1.) direct digital injection into the bit stream within the digital radio controller, and 2.) direct analog coupling of error pulses into the digital radio controller TxData driver interface.

The first method is illustrated in Figure 3. Here, a digital test port is provided in the digital radio controller logic in order to allow externally input data to be Ex-or'd into the digital stream during a certification test. The provision may be part of the test capability of the digital radio controller IC or otherwise somehow implemented in the reference platform. Whenever the test port input is asserted, the normal transmit data polarity is inverted in real time, causing bit errors in the TxData stream. The error pulses may be implemented from an external generator that is producing narrow digital pulses by random or pseudo-random triggering. The injected bit error rate can be regulated by the triggering frequency and pulse-width of the test source.

Figure 3: Digital Method for Injection of Interface Error Pulses

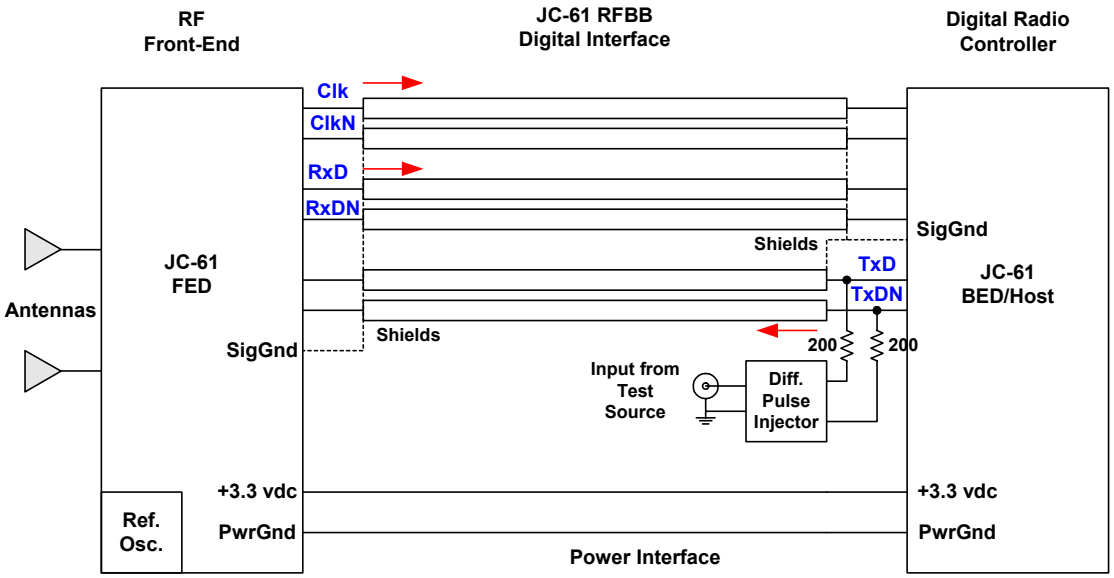


Line Driver with Ex-or'd Test Input Port



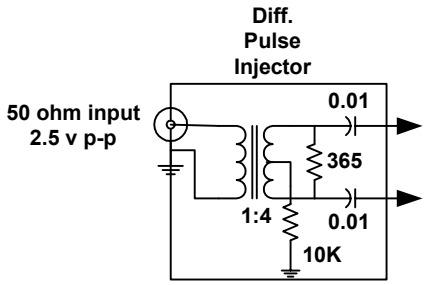
The second method is illustrated in Figure 5. This method involves direct coupling of an analog error pulse source on the transmitter side of the TxData interface pair.

Figure 5: Analog Method for Injection of Interface Error Pulses



An example differential pulse injector circuit is shown in Figure 6.

Figure 6:



This example assumes a 100 ohm differential termination impedance for the TxData differential line driver/receiver. The transformer circuit of Figure 6 generates large differential pulses that override the normal driver output amplitudes of the JC-61 differential interface. The relatively high source impedance of this injector circuit ensures negligible disturbance of the normal operating impedances and voltages of the doubly terminated JC-61 transmission line interface.

Both the digital and analog error pulse injection methods would use a similar external 50 ohm test signal source. For example, the interference test source might consist of a pulse generator producing narrow pulses (e.g. 5 ns to 10 ns) and triggered from a PRN sequence generator running at a lower rate (e.g. 20 MHz). This would generate error pulses with pseudo-random spacing on 50 ns centers at a frequency unrelated to the digital interface clock.

These examples are meant for informational purposes only. Specific test requirements and parameters are not meant to be suggested here, only an example methodology.

It is assumed that the appropriate signal injection method and parameters would be provided in the reference platform design submitted for FCC certification testing.

SERVICE LIST

Chairman Michael Powell
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Commissioner Kathleen Q. Abernathy
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Commissioner Michael J. Copps
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Commissioner Kevin J. Martin
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Commissioner Jonathan S. Adelstein
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Edmond J. Thomas, Chief, OET
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Julius P. Knapp, Deputy Chief, OET
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Bruce A. Franca, Deputy Chief, OET
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

James D. Schlichting, Deputy Chief, OET
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Michael Marcus
Associate Chief for Technology, OET
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Alan J. Scrime, Chief
Policy & Rules Division, OET
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Ira Keltz, Deputy Chief
Policy & Rules Division, OET
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Geraldine Matise, Deputy Chief
Policy & Rules Division, OET
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Karen E. Rackley, Chief
Technical Rules Branch, OET
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Neal McNeil
Technical Rules Branch, OET
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

John A. Reed
Technical Rules Branch, OET
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554